Review of Carbon TerraVault (CTV) Responses to EPA's Questions on the Proposed Emergency and Remedial Response Plan

In December 2021, EPA provided questions to CTV about the draft Emergency and Remedial Response Plan submitted as part of CTV's Class VI permit application (dated August 30, 2021). CTV provided an updated Emergency and Remedial Response Plan to EPA on March 2, 2022. EPA's evaluation of how the updated plan addresses its questions is presented in red below. Requests for revisions and additional information are presented in ***red, bold, and italic*** below.

Potential Risk Scenarios

The list of items in this section does not match the events and scenarios described in the following section.

- ***Please revise the list.***

The list in this section also includes "CO_2 leakage to USDW or land surface," which appears to also be addressed under the "Potential Brine or CO_2 Leakage to a USDW" scenario.

- ***Please delete this item.***

Emergency Identification and Response Actions

EPA recommends some additions/revisions to the descriptions and response actions for the scenarios identified in the Emergency and Remedial Response Plan. These are presented in the table below:

Event/Scenario	EPA Comment/Recommendation	Evaluation of CTV's Updated Plan
1. All	a) EPA recommends that the Actionable Testing limits methods in Table 7 of the QASP be referenced in the Emergency and Remedial Response Plan.	a) This addition was not made. ***Please add to the introduction that the Emergency and Remedial Response Plan would be implemented in response to events that could be detected in the course of monitoring pursuant to the Testing and Monitoring Plan, including exceedances of Actionable Testing limits described in the QASP.*** ***Under the "Brine or CO_2 Leakage to USDW" scenario, please add other indicators of leakage including elevated pH levels in the Tulare Formation (e.g., 0.2) and pressure increases in the Etchegoin Formation of 0.001 psi detected by the pressure gauge.***

Event/Scenario	EPA Comment/Recommendation	Evaluation of CTV's Updated Plan
2. Well Integrity Failure	a) A mechanical integrity (MI) failure of a monitoring well can also occur in the post-injection time frame; please update the "timing of the event" accordingly. b) The statement that CTV must notify the UIC Program Director is not an event that may signal loss of MI. Please make this a separate statement outside of the list on page 3. c) Consider including "Limit access to wellhead to authorized personnel only" to the response actions for major and minor emergencies. d) The response to a major or minor MI failure should also include necessary actions to identify the location/nature of the damage to the well or wellhead and confirm internal and external integrity prior to restarting injection (upon approval of the UIC Program Director).	***a) Please edit the timing of this event from "Injection/monitoring" to "injection/post-injection."*** b) The requested change was made. No further questions. c) The requested change was made. No further questions. d) The requested changes were made. Note that there is a typo on page 5, "Preform a well log...". ***Please correct the typo.***
3. Well Integrity Failure – Major or Serious Emergency	a) Please clarify what would constitute a major or serious emergency (e.g., a verified loss or increase of pressure or fluid volumes and/or loss of mechanical integrity is discovered). b) Response to a major emergency may also include communicating with CTV personnel or other operators in the field and local authorities to initiate evacuation plans, as necessary.	a) The requested change was made. No further questions. b) The requested change was made. No further questions.
4. Well Integrity Failure – Minor Emergency	a) Please clarify what would constitute a minor emergency (e.g., downhole and surface sensor/monitoring equipment failure, procedural maintenance error or plant issue). b) Clarify that, if contamination is detected or a loss of integrity has occurred, then the situation becomes a major emergency and the actions under "Major or Serious Emergency" would be taken. c) "Initiate shutdown plan" is on the list of response actions twice.	a) The requested change was made. No further questions. b) The revised text is acceptable. No further questions. c) No further questions.

Event/Scenario	EPA Comment/Recommendation	Evaluation of CTV's Updated Plan
5. Injection Well Monitoring Equipment Failure – Major or Serious Emergency	a) Please describe what constitutes a Major or Serious emergency (e.g., failure of sensors that will require shutdown of well to repair, extended repair time, and/or well reentry). b) Responses to a Major monitoring equipment failure emergency may also include: • Verifying whether any contamination has occurred (e.g., via handheld CO_2 monitors). • Communicating with CTV personnel/other operators in the field and local authorities to isolate the area or initiate evacuation plans, as necessary if contamination is detected. • Demonstrating internal and external well integrity prior to restarting injection (upon approval of the UIC Program Director).	a) The requested change was made. No further questions. b) The requested changes were made. No further questions.
6. Injection Well Monitoring Equipment Failure – Minor Emergency	a) Please describe what constitutes a Minor emergency (e.g., sensor or monitoring failure that does not require shutdown of the well to repair). b) Potential response actions may also include actions to identify the location/nature of the damage and reset monitoring devices and/or confirm internal and external well integrity prior to restarting injection (upon approval of the UIC Program Director). c) "Initiate shutdown plan" is on the list of response actions twice.	a) The requested change was made. No further questions. b) The requested changes were made. No further questions. c) The requested change was made. No further questions.

Event/Scenario	EPA Comment/Recommendation	Evaluation of CTV's Updated Plan
7. Potential Brine or CO_2 Leakage to USDW	a) EPA recommends that the introduction to this scenario be broadened to encompass any evidence of CO_2 or fluid movement out of the injection zone (i.e., not necessarily to a USDW) to address events associated with unanticipated fluid movement pathways, any potential USDW endangerment/unacceptable changes in water quality, and CO_2 leakage to the land surface.	a) The response actions address CO_2 or fluid movement out of the injection zone (e.g., to the Etchegoin) or CO_2 detected by hand-held monitors at the surface. No further questions.
	b) The severity of an event involving CO_2/brine leakage to a USDW would be serious, not low.	b) The requested change was made. No further questions.
	c) Detection methods may also include pressure or water quality changes in the Etchegoin Formation monitoring well.	c) The requested change was made. No further questions.
	d) The response actions should also address well integrity issues (e.g., by following responses under the MI failure scenario) or a risk to air quality (i.e., to isolate the nearby area and establish a perimeter using a hand-held air-quality monitors).	d) The requested change was made. No further questions.
	e) The response equipment for this scenario should also include groundwater remediation equipment.	e) The requested change was made. No further questions.
8. Natural Disaster	a) The severity of these types of events could range up to serious or catastrophic.	a) The requested change was made. No further questions.
	b) These types of events may occur in any of the project phases (e.g., construction and post-injection) not just the injection phase.	b) The requested change was made. No further questions.
	c) For Major or Serious natural disasters, potential response actions may also include: • Initiating evacuation procedures; • Referencing the response actions described under the CO_2 leakage scenario if contamination or endangerment of a USDW is detected; or • Confirming mechanical integrity/taking appropriate steps if an injection/monitoring well has been damaged.	c) The requested changes were made. No further questions.

Event/Scenario	EPA Comment/Recommendation	Evaluation of CTV's Updated Plan
9. Induced Seismic Event	a) This section and the title should refer to induced or naturally occurring seismic events since all seismic events have the potential to affect the injection wells and the necessary responses would be the same.	a) The requested change was made. No further questions.
	b) It is unclear whether the area encompassed by "the AoR inclusive of a ¼ mile buffer," as described on page 8 is as large as a 2-mile radius of the injection wells, as described on Table 2. Please modify the introductory statement to reflect the area addressed in Table 2.	***b)*** The introduction now refers to epicenters "within the AoR, inclusive of a two mile buffer" and Table 2 refers to "a two-mile radius of the injection well." ***Please revise the table to be consistent with the introduction.***
	c) The severity of seismic events could be major.	c) The requested change was made. No further questions.
	d) Seismic events that may necessitate a response could occur during the injection or post injection phases.	d) The requested change was made. No further questions.
	e) Please clarify what is meant by "seismic monitoring wells" as a detection method; EPA assumes this refers to the monitoring network that is described in the Testing and Monitoring Plan, and therefore recommends that similar terminology be used.	e) The requested change was made. No further questions.
10. Induced Seismic Event—Table 2	a) Please modify the title to Table 2 to be consistent with the magnitude in the green response level (i.e., M 1.5).	a) The requested change was made. No further questions.
	b) Please explain how the selected seismic thresholds (i.e., magnitude, distance from the project) are considered protective of USDWs.	b) The table has been revised to tie the magnitude-specific responses to USDW protection. No further questions.
11. Induced Seismic Event—Table 2, Green Level	a) Add the response action: Document the event in semiannual reports to EPA.	a) The requested change was made. No further questions.

Event/Scenario	EPA Comment/Recommendation	Evaluation of CTV's Updated Plan
11. Induced Seismic Event—Table 2, Yellow Level	a) Potential response actions should also include: • Initiate gradual shutdown of the well if it is determined to be appropriate. • Review seismic and operational data to determine the location and magnitude of seismic event. If the event falls within or near the extents of the plume, estimate potential impact to USDWs. Perform a pressure falloff test to determine if the storage complex has been compromised by the seismic event. • Document the event in semiannual reports to EPA.	a) The requested changes were made. No further questions.
12. Induced Seismic Event—Table 2, Orange Level	a) EPA recommends the following additions to the response actions: • Initiate gradual shutdown of the well if it is determined to be appropriate. • Document the event in semiannual reports to EPA. • Expand Step 3 on reviewing seismic and operational data to describe additional actions if the event falls within or near the CO_2 plume (e.g., to estimate potential impact to USDWs or determine if the storage complex has been compromised by the event).	a) The requested changes were made. No further questions.
13. Induced Seismic Event—Table 2, Magenta Level	a) EPA recommends the following changes to the response actions: • Please describe the "rate reduction plan" in Step 1. Does this refer to gradual shutdown? • Expand Step 8 to apply to USDW contamination/endangerment and a CO_2 leak. • Expand Step 9 on reviewing seismic and operational data to describe additional actions if the event falls within or near the CO_2 plume (e.g., to estimate potential impact to USDWs or determine if the storage complex has been compromised by the event). • Add: Document the event in semiannual reports to EPA.	a) The rate reduction plan was not described. ***Please describe this procedure or clarify in the E&RR Plan if it refers to gradual shutdown of the well.***

Event/Scenario	EPA Comment/Recommendation	Evaluation of CTV's Updated Plan
14. Induced Seismic Event—Table 2, Red Level	a) EPA recommends the following changes to the response actions: • Expand Step 8 to apply to USDW contamination/endangerment and a CO_2 leak. • Expand Step 9 on reviewing seismic and operational data to describe additional actions if the event falls within or near the CO_2 plume (e.g., to estimate potential impact to USDWs or determine if the storage complex has been compromised by the event).	a) The requested changes were made. No further questions.

Response Personnel and Equipment

a) Are any of the personnel to be notified a 24-hour contact, such as a 24-hour emergency coordinator in the control room? If so, please include this in the plan. The requested change was made; EPA has no further questions.

b) In Table 3, EPA recommends the following additions/changes: The requested changes below were made. ***Please fix the typo, "EOA Region 9."***

- The UIC Program Director will be an EPA Region 9 staff person (David Albright albright.david@epa.gov.
- Consider also including: the local/community medical center, Poison Control Center, California Office of Emergency Services, and the State Water Quality Control Board.

Staff Training and Exercise Procedures

There are several typos in this section; please revise.

- Several typos remain, e.g., mis-spelling of facilities, maintenance, monitors, hazards, exercise. ***Please fix these.***